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EVALUATION OF THE BERG EMISSION CONTROL SYSTEM

Henry L. Gompf

Environmental Protection Agency
Ann Arbor, Michigan

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Henry L. Gompf
Test and Evaluation Branch
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16. Abstracts

An evaluation was initiated of a modified emission control system. The Berg System performs two functions. The primary effect is that of bleeding additional air to the intake manifold, thus leaning combustion. The second function is to supply fuel vapors from the gasoline tank to the intake manifold. The test vehicle was a 1963 Ford Galaxie, equipped with a 289 cu. in. displacement engine and automatic transmission. Three different configurations of the Berg System were evaluated. Baseline or stock vehicle testing was conducted before, during, and after the device testing. All tests were performed according to the 1972 Federal Emission Test Procedure. The Berg System is a simple air bleed device. Depending on the quantity of bleed air, the system reduces hydrocarbon and carbon monoxide levels. Maximum reductions of 29% and 64% were obtained during the evaluation. Further investigation is needed to determine the proportion of in-use vehicles which would be adversely affected by this system.

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Nitrogen oxides
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Berg Emission Control System
Federal Emission Test Procedure (1972)

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Background

The Berg Emission Control System was initially evaluated in Cincinnati, Ohio, by the National Air Pollution Control Administration. That testing indicated substantial reductions in hydrocarbon, and carbon monoxide. The validity of the results was questioned, however, due to the use of smaller metering jets and adjustment of idle carbon monoxide to a lean level of .5%. Gordon C. Berg, the developer, approached the Environmental Protection Agency with a modified system in September, 1971. It was decided, based upon the previous testing and the system's potential applicability to used, uncontrolled motor vehicles, to initiate an evaluation of the modified system.

System

The Berg System performs two functions. The primary effect is that of bleeding additional air to the intake manifold thus leaning combustion. The second function is to supply fuel vapors from the gasoline tank to the intake manifold. The hardware required to accomplish this two-fold approach is minimal. The PCV valve is removed leaving the line from the crankcase to the carburetor in place. A plastic fitting topped with a tee is inserted in this line. One side of the tee is connected to a hose running to the fuel tank cap which has been fitted with a small bore copper tube to allow flow-through of gasoline vapors. The other side of the tee is left open to atmosphere as a source of bleed air. The size of this orifice can be varied depending on the desired bleed-air rate. The effect of this system is to add a mixture of air and fuel vapors to the PCV system. The flow through the PCV system is no longer metered by the PCV valve.

Test Program

A 1963 Ford Galaxie was selected as the vehicle to be used in the evaluation program. This vehicle was equipped with a 289 cubic inch displacement engine and had an automatic transmission. Three different configurations of the Berg System were evaluated. They differed each time through increasing the bleed-air rate accomplished by enlarging the open side of the tee or adding additional bleed holes to the base of the tee.

Baseline or stock vehicle testing was conducted before, during and after the device testing. All tests were performed according to the 1972 Federal Emission Test Procedure as described in the November 10, 1970, Federal Register. This testing employed the

LA4-S4 driving cycle and the constant volume sampling technique for obtaining bag samples. These samples were analyzed using NDIR analysis for carbon monoxide and carbon dioxide, FID analysis for hydrocarbons, and chemiluminescence analysis for oxides of nitrogen.

Results

The actual test by test emission results are presented in the Appendix of the report. The following table indicates the percent reductions from baseline for each of the three configurations of the Berg system that were tested.

Percent Reduction From Baseline

	HC	CO	CO_2	NOx
1st Berg	0%	9%	-3% inc	---
2nd Berg	13%	34%	-6% inc	---
3rd Berg	29%	64%	-10% inc	-23% inc

This data reveals the effect of increasing bleed-air rates on the emissions. The major effect of leaner combustion is seen in the reduction of carbon monoxide with a smaller yet progressively increasing reduction in hydrocarbon levels. The increased availability of oxygen during the combustion process result in higher temperatures and increased levels of oxides of nitrogen. The vapor line system was not modified once it was installed. It can be predicted that this added fuel effect was offset by addition of larger quantities of bleed air. Because of the vapor line connection, analysis of potential safety hazards should be made. Simple provisions for filtering bleed air would eliminate the harmful effects of air-born dirt to the engine.

Conclusions

The Berg System, in essence is a simple air bleed device. Depending on the quantity of bleed air, the system reduces hydrocarbon and carbon monoxide levels. Maximum reductions of 29% and 64% respectively, were obtained during the evaluation. The leaner combustion resulted in increased emissions of oxides of nitrogen.

Since the system works on the principal of increasing the air fuel ratio regardless of what that ratio was initially, it is predictable that certain vehicles already operating near the lean limit air-fuel ratio could suffer misfire, stumble and

surge. There is no estimate as to the proportion of the in-use vehicles which would be affected in this manner. It is, however, a consideration which deserves further investigation.

APPENDIX

1972 FEDERAL EMISSION TEST RESULTS ON 1963 FORD

(All results are in grams per mile)

Baseline	Test#	Date	HC	CO	CO_2	NOx
	18-0026	11/3/71	7.1	93.9	450.5	---
	18-0030	11/2/71	7.3	83.4	423.7	---
	18-0034	11/4/71	7.1	94.9	455.7	---
	18-0038	11/8/71	7.6	95.8	439.0	---
Average Initial Baseline			7.3	92.0	442.2	---
1st Berg Approach						
	18-0059	11/24/71	6.7	80.7	455.3	---
	18-0064	11/26/71	8.2	86.1	476.5	---
Average First Approach			7.5	83.4	465.9	---
2nd Berg Approach						
	18-0067	11/29/71	7.0	64.2	478.5	---
	18-0068	11/30/71	5.9	56.6	479.11	---
Average Second Approach			6.5	60.4	478.8	---
Interum Baseline						
	18-0100	12/30/71	8.2	114.1	413.0	---
	18-0100	1/3/72	7.9	82.5	484.3	---
	18-0105	1/4/72	7.3	83.5	480.6	---
	18-0106	1/5/72	7.2	87.1	460.6	---
Average Interum Baseline			7.7	91.8	459.6	---
Average First and Interum Baseline			7.5	91.9	450.9	---

This series of testing is treated separately as a different analysis train was employed with inherently different test errors.

	Test#	Date	HC	CO	CO_2	NOx
3rd Berg Approach	12-2084	1/7/72	5.9	37.9	598.8	5.8
	12-2089	1/11/72	5.7	36.8	563.8	5.7
	12-2096	1/13/72	5.6	36.8	559.3	4.5
	12-2094	1/12/72	5.8	42.8	565.5	5.4
Average 3rd Berg Approach			5.8	38.6	571.9	5.4
Final Baseline	12-2101	1/17/72	8.9	112.5	504.8	4.1
	12-2104	1/18/72	8.7	118.8	563.7	4.7
	12-2108	1/19/72	7.0	97.8	521.4	4.1
	12-2114	1/20/72	8.3	105.3	487.4	4.7
Average Final Baseline			8.2	108.6	519.3	4.4